APPARATUS, BASED ON A NEW PRINCIPLE OF OPERATION, FOR CARRYING OUT HETEROGENEOUS CATALYTIC PROCESSES IN THE VAPOUR PHASE[1]

Preliminary Communication

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On conducting heterogeneous catalytic processes in the vapour phase, the effectiveness of the reaction and the preciseness of reproducibility are reduced to a great extent by the experimental fact that in the case of strongly exothermic and endothermic reactions, appreciable differences of temperature exist between the different points of the catalyst space. These differences of temperature are responsible for the local overheating and cooling, respectively, of the catalyst. Around these points of too high and too low temperature, respectively, the reactions do not take the desired course. A great number of attempts have been made to secure the desired direction of reactions in the vapour phase: among others, the tube bundle, the moving and the fluid bed types of reactors were evolved. Reactors consisting of tube bundles are expensive and their operation is inconvenient whilst reactors of moving and fluid bed suffer from the disadvantages of possessing high operating costs, due to the quick wear out of catalysts, further of having a complicated mechanism. A common disadvantage of all three methods is that difficulties are encountered when plants are to be enlarged.

The above-mentioned disadvantages are eliminated by the new type „melt-bed" reactor evolved by the author. Melted catalysts are applied in place of the solid ones so far used. The method consists, in essence in bubbling the gas-phase mixture of the components to be reacted through a melt of 200—600°C temperature which acts as catalyst. The components of the adequately distributed gaseous mixture, on passing the melted catalyst, react with each other under the catalytic effect when they reach the boundary of the gaseous and the liquid phase. The quick conductance of the heat of reaction is secured by the fair conductivity and movement of the catalyst applied. In order to promote the quickness of heat transfer, the melt is maintained in a constant circulation or stirred in an adequate way.

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Metals of low melting point, such as lead, zinc, tin, bismuth and their mixture, respectively, or nonmetallic inorganic substances and their mixture, respectively, with melting points in the temperature interval 200—600°C may serve as melts. It is possible to affect in this way the various reactions to a remarkable extent, depending on the nature and ratio of the gaseous mixture applied, and on the state and electronic system of catalysts.

After introducing the new principle at the design of reactors, it was extremely difficult to secure an adequate contact time and surface. The problem was solved with success by the application of a fixed bed of pumice stone, immersed in the melt, further of a column of ceramic bodies.

The proposed new method has the advantage of maintaining an approximately identical temperature in the whole catalyst space *i. e.* both in a vertical and in a horizontal direction. Individual temperature gradients of catalysts consisting of pieces of substances are also eliminated in this way. Namely, in the melt-bed reactor, the reaction takes place on the boundary of phases which serves at the same time also as a heat exchange surface. The favourable heat exchange conditions make possible, in contrast to other types of reactors, that melt-bed reactors can be easily enlarged, a fact of great importance from the point of view of chemical engineering. Easiness of operation, cheapness of construction and long duration of the catalysts applied are similarly properties of a favourable nature.

On using the proposed method, we succeeded *e. g.* in carrying out the conversion furfural → furane at a conversion rate of 93% in the presence of metallic lead as catalyst.

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